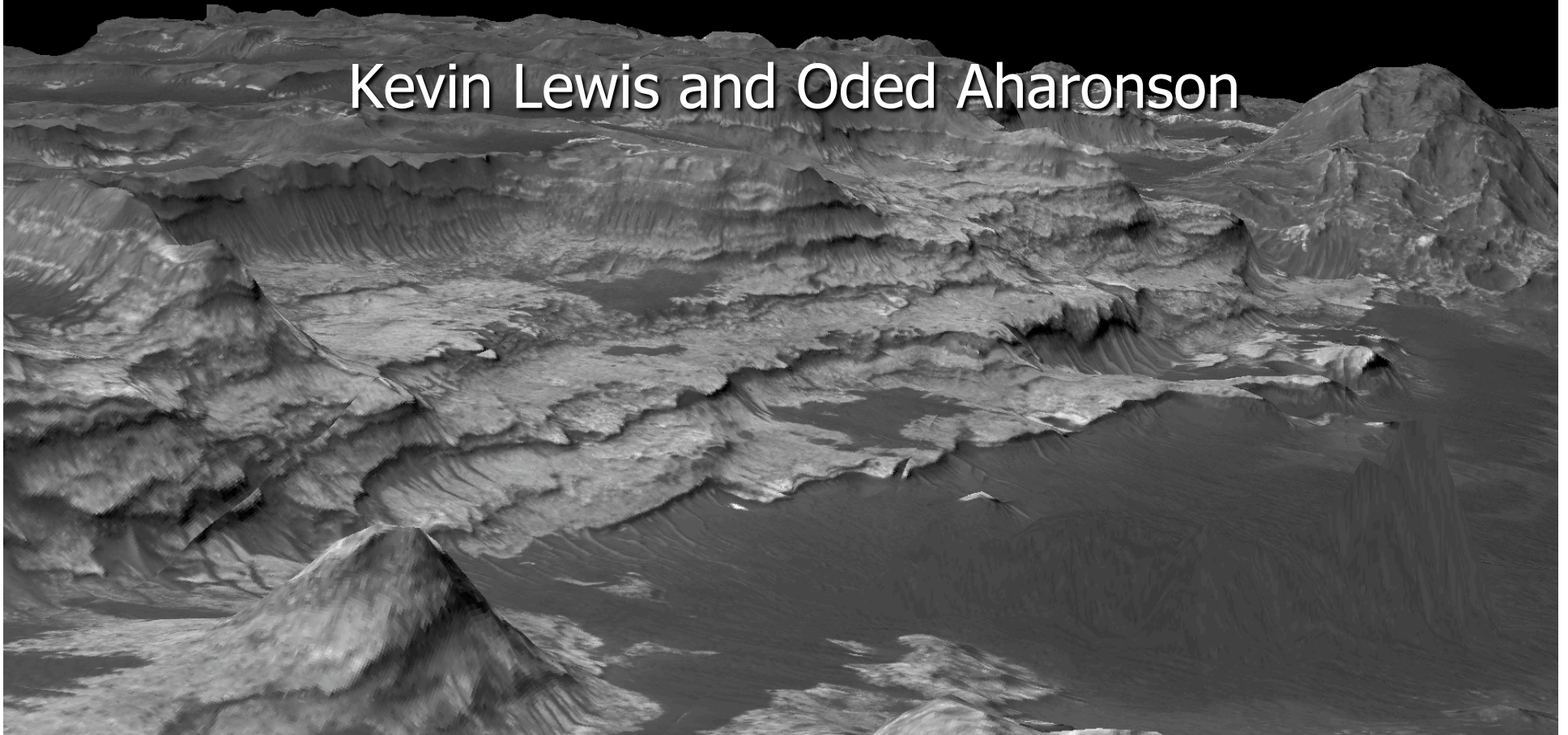


Eberswalde MSL Landing Site

*Geomorphic Aspects of the Eberswalde
Delta and Potential MSL Traverses*

Kevin Lewis and Oded Aharonson

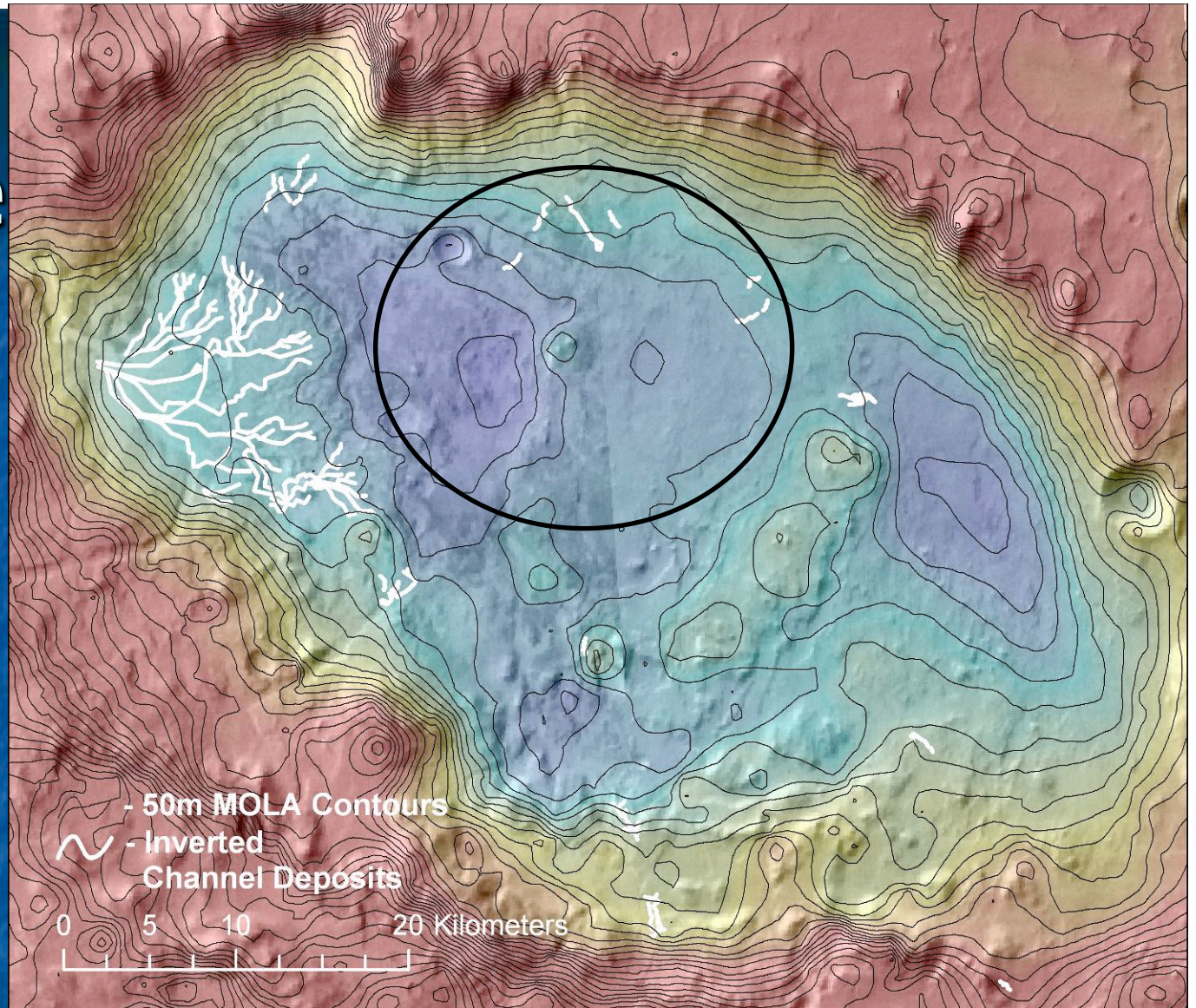


MSL Critical questions

- Can multiple rock units be observed from orbit?
- Do these units have well defined stratigraphic and/or cross-cutting relationships?
- Do these units show diverse mineralogic and/or geomorphic features?
- How strong is the evidence that these features formed through interaction with water?
- Can multiple working hypotheses be developed for the interpretation of key features, and if so, can the MSL payload enable us to differentiate among alternatives?

Diversity	Context
Habitability	Preservation

Eberswalde Overview



- While the main delta is located to the west of the landing ellipse, other fluvial deposits are accessible within the ellipse

Diversity

Context

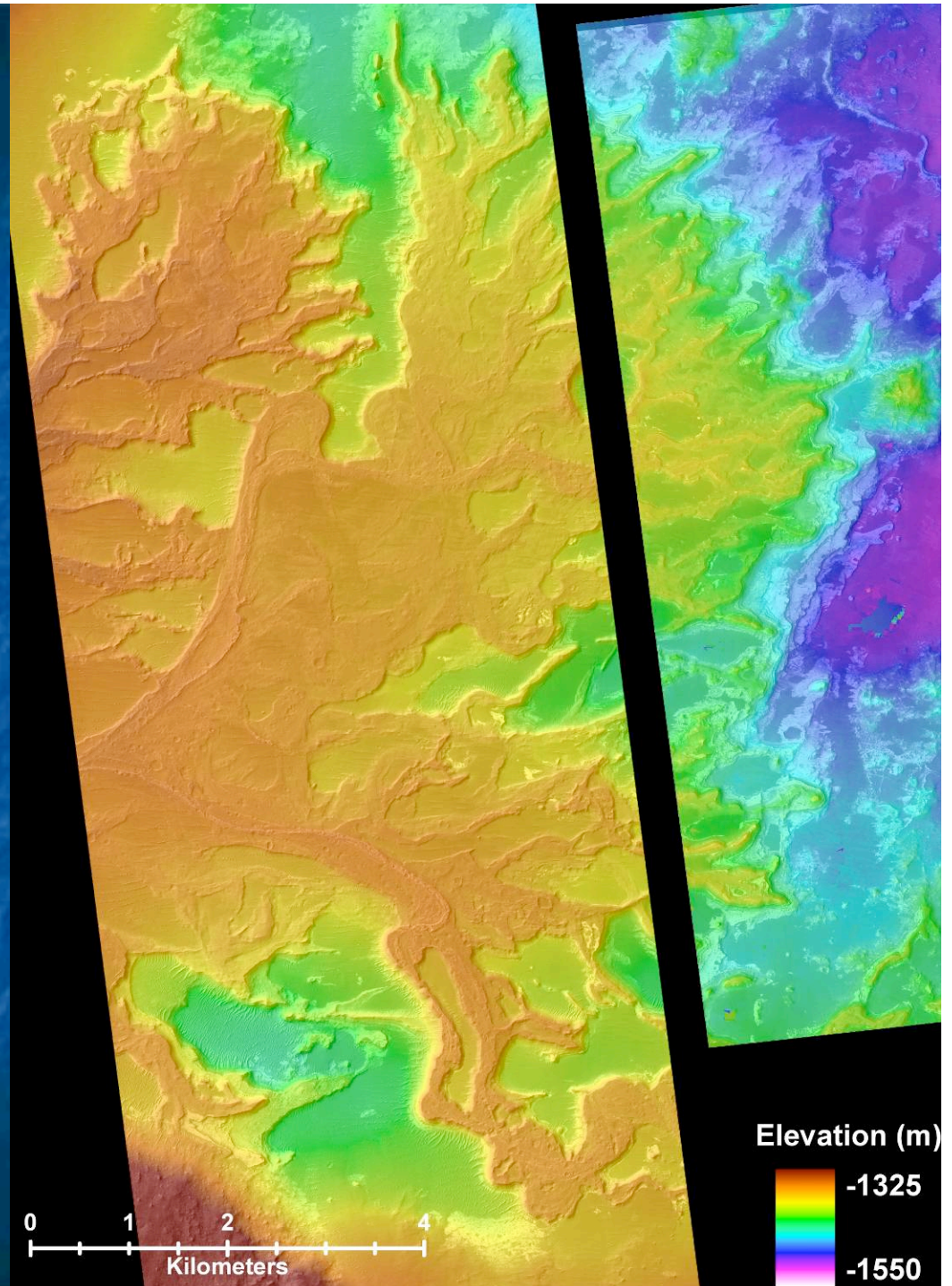
Habitability

Preservation

HiRISE

Stereo Topo

- Channels are topographic highs and can be traced across delta surface
- Multiple lobes indicate several stages of construction
 - Base level drops between lobes, which is **inconsistent with an alluvial fan** in a closed basin
- Channels occur at varying elevations, indicating an overall aggradational system



Diversity

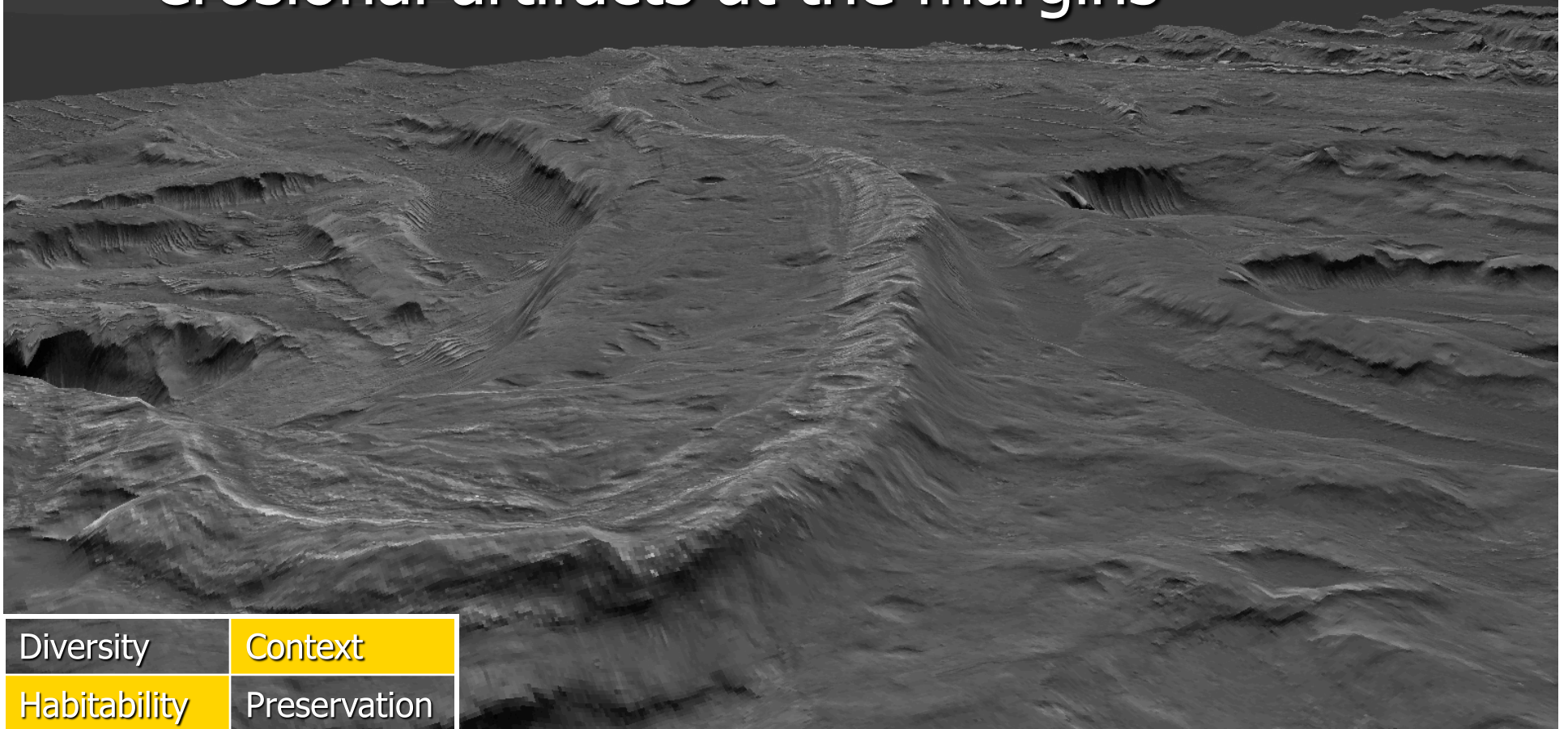
Context

Habitability

Preservation

Evidence for a fluvial deposit

- Inverted channels are topographic highs across the delta surface, not simply erosional artifacts at the margins



Diversity

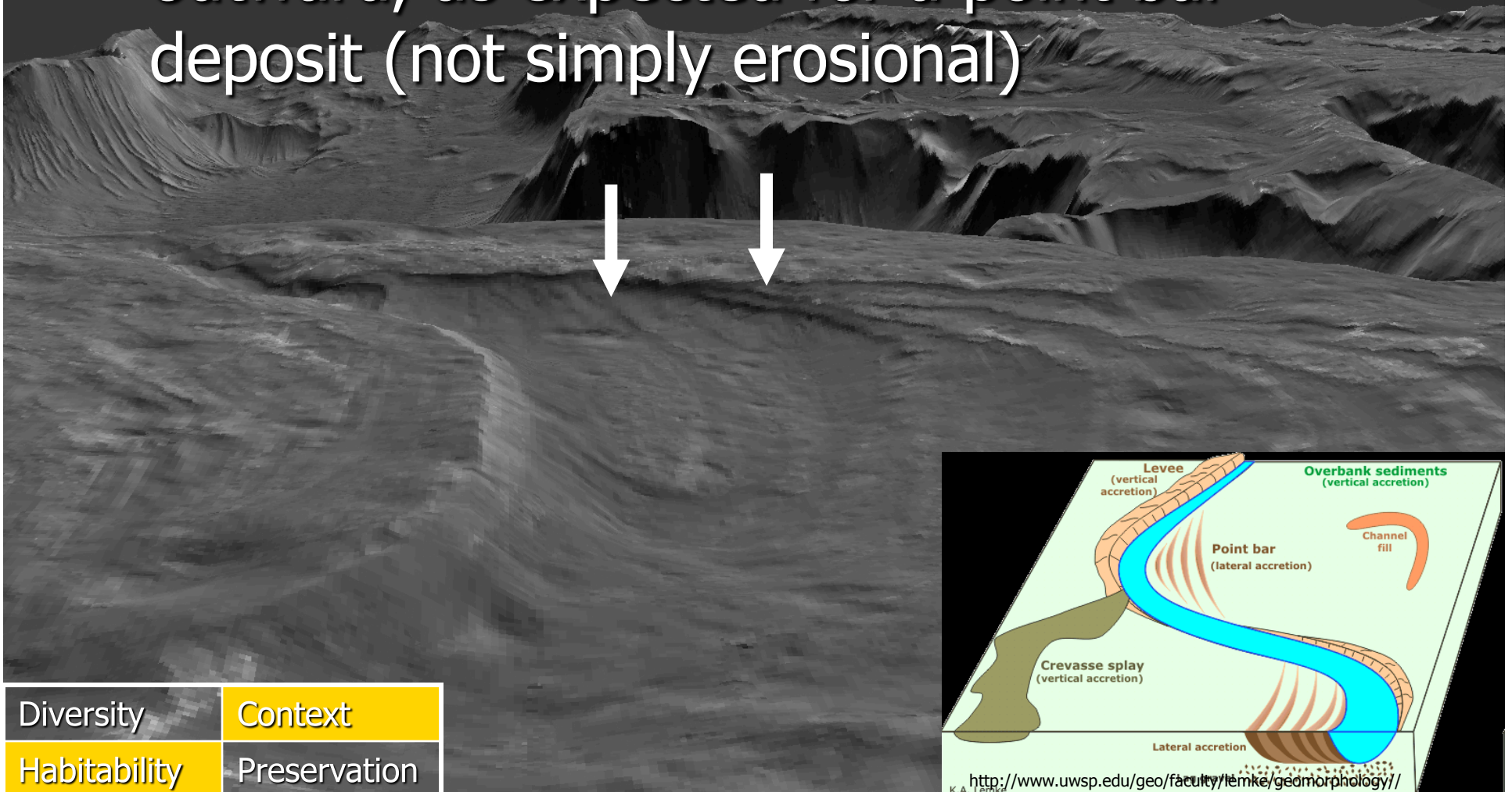
Context

Habitability

Preservation

Evidence for a fluvial deposit

- Strata exposed in meander bend dip outward, as expected for a point bar deposit (not simply erosional)



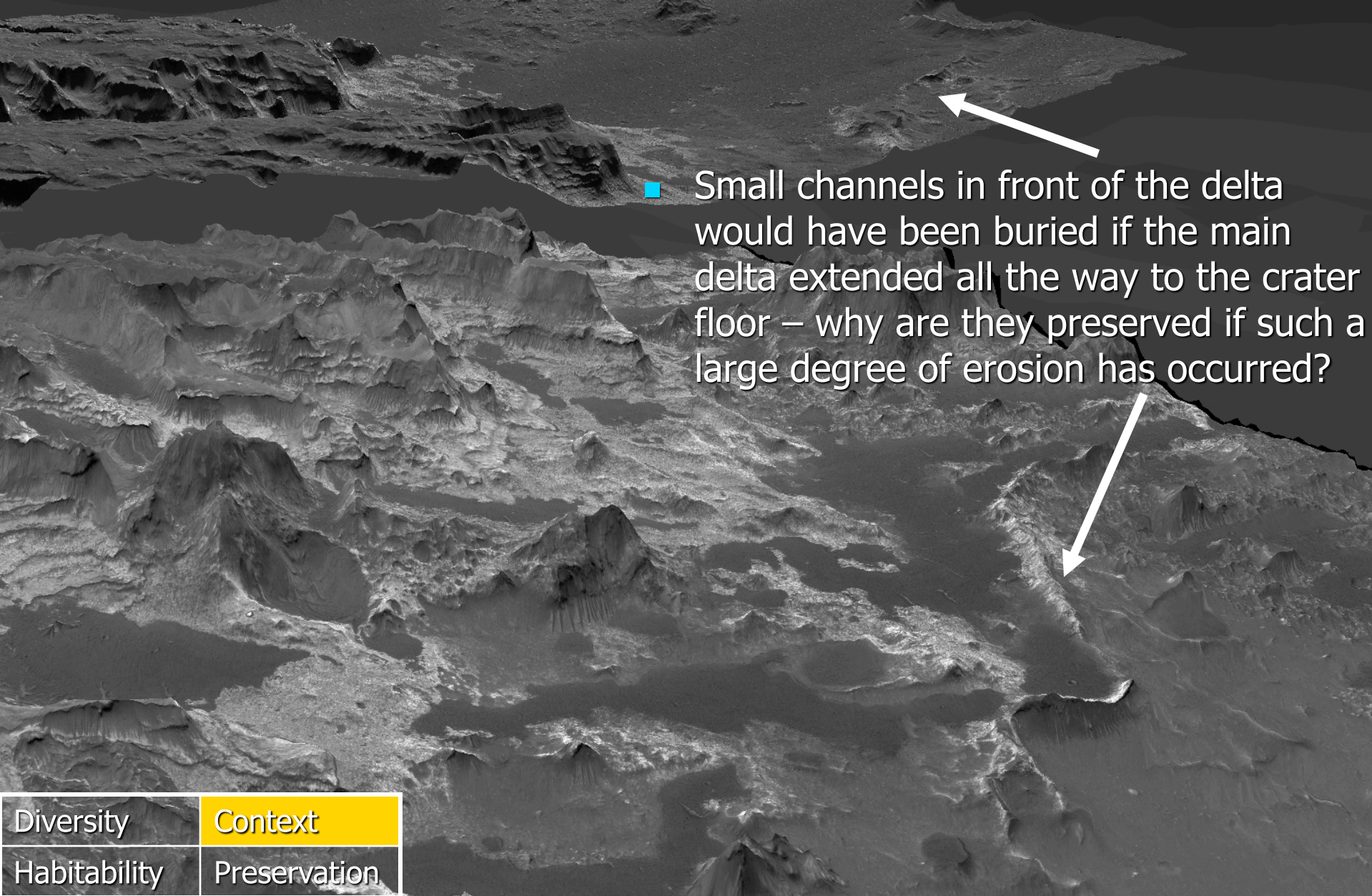
Diversity

Context

Habitability

Preservation

Delta vs. alluvial fan

- 
- Small channels in front of the delta would have been buried if the main delta extended all the way to the crater floor – why are they preserved if such a large degree of erosion has occurred?

Diversity

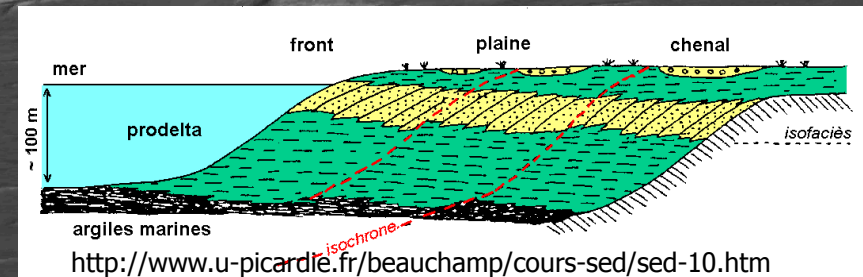
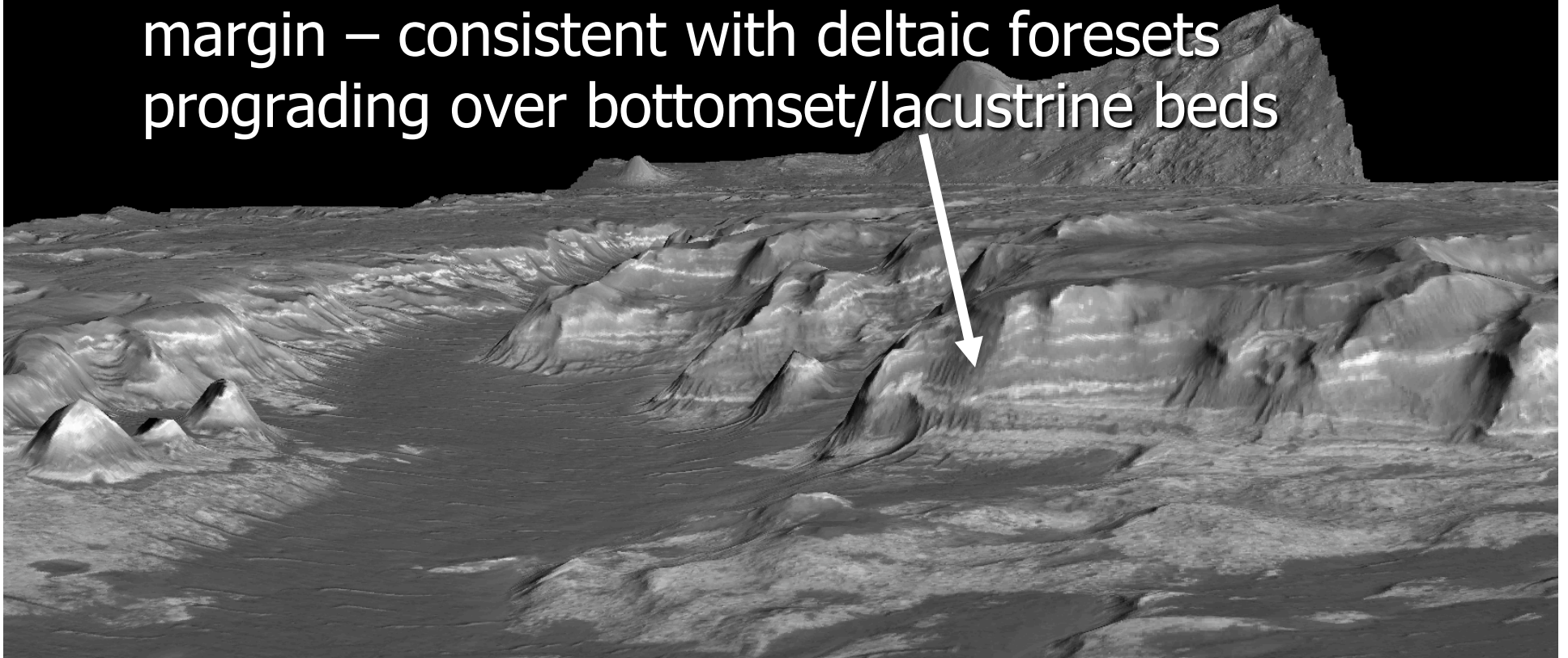
Context

Habitability

Preservation

Deltaic Geometry

- Downlap relationship observed on northern margin – consistent with deltaic foresets prograding over bottomset/lacustrine beds

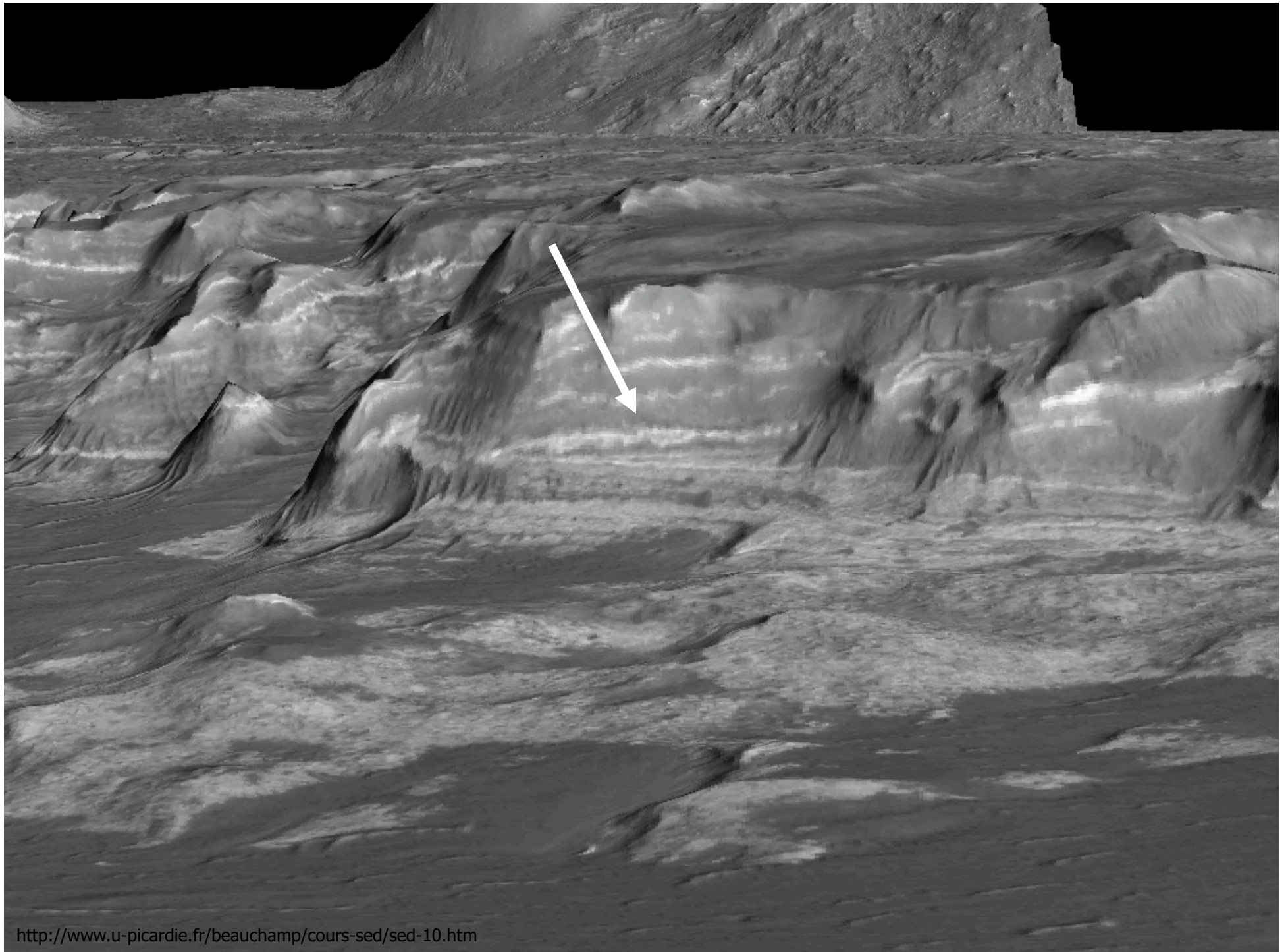


Diversity

Context

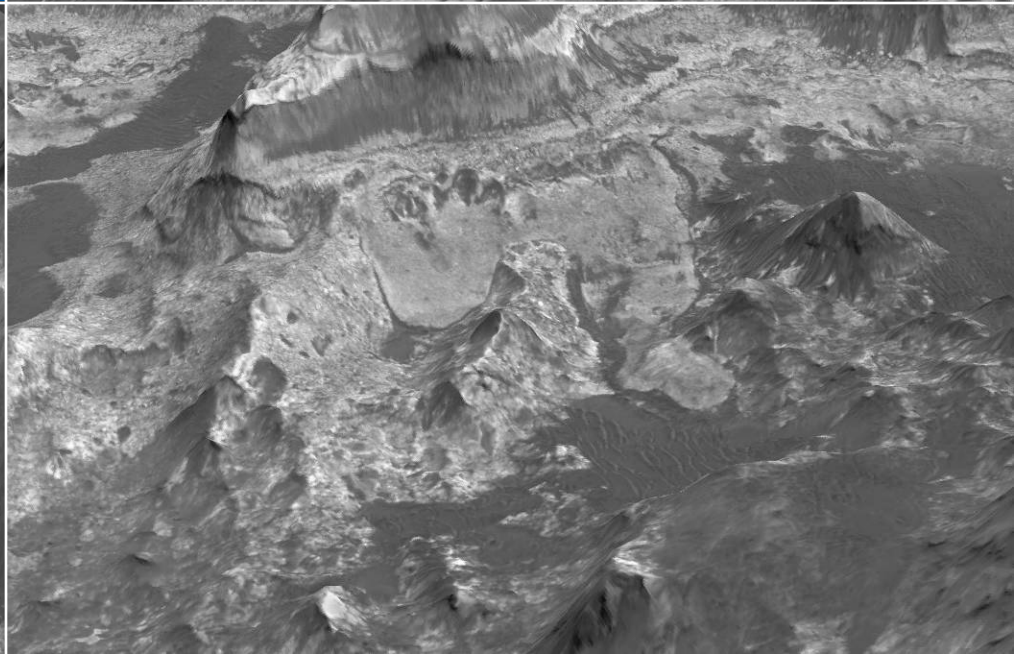
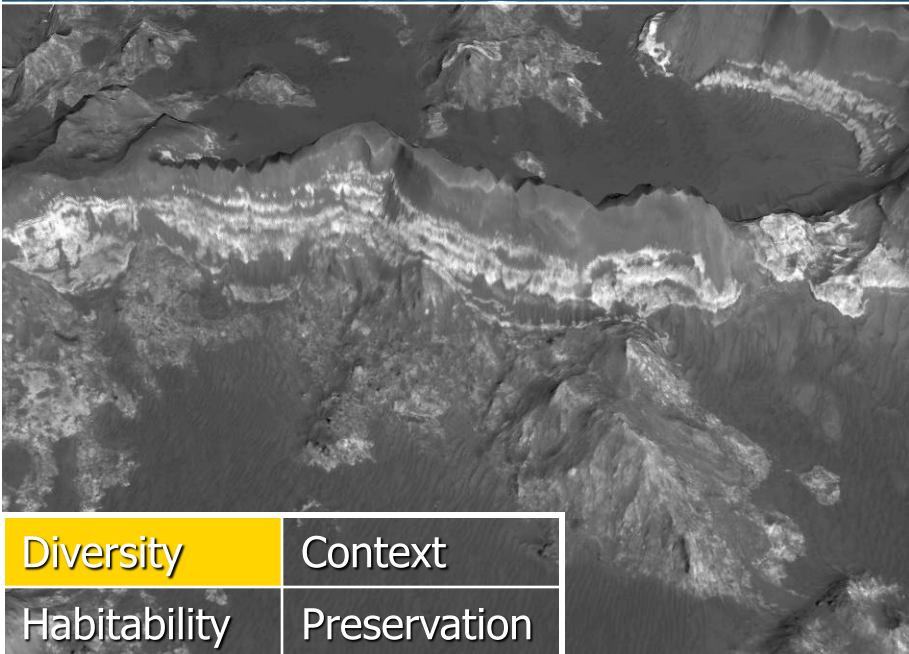
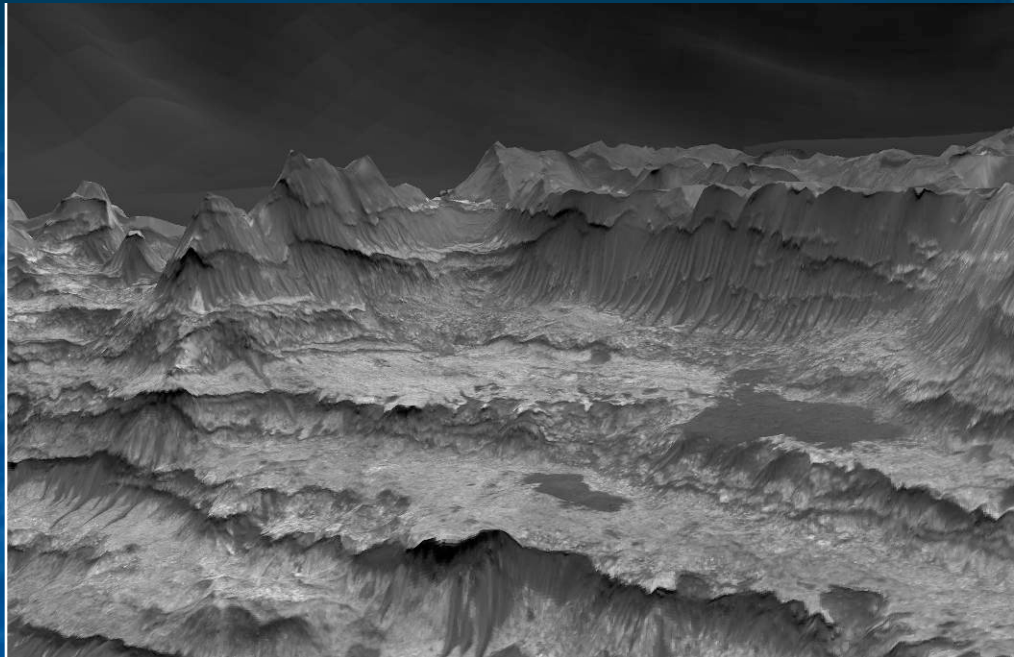
Habitability

Preservation



Geologic contacts

- Truncated layers
- Non-planar contacts
- Every location would expose slightly different stratigraphy



Diversity

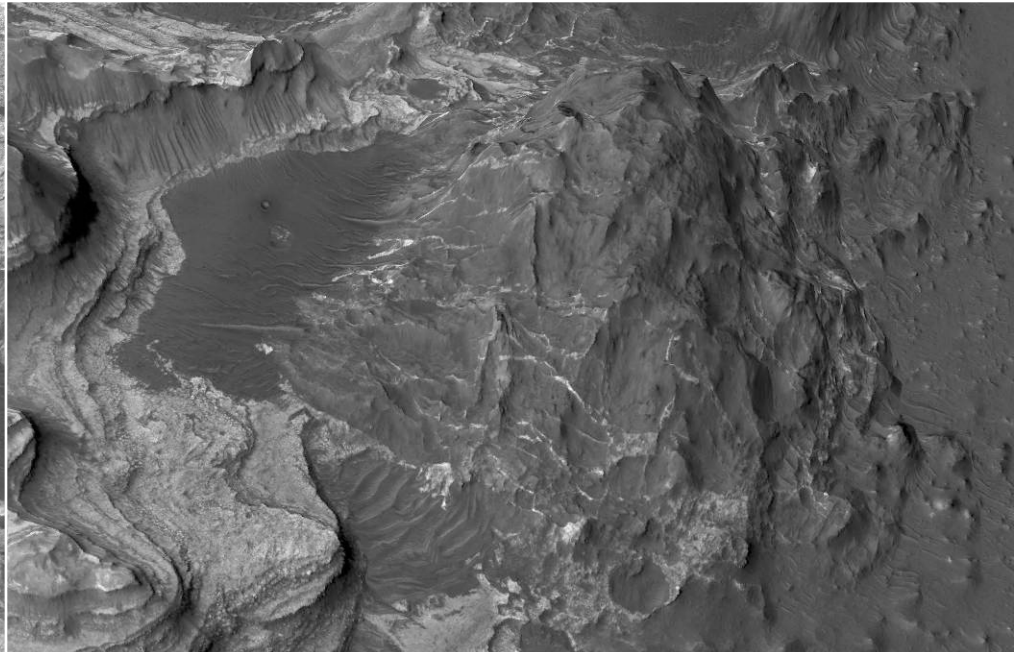
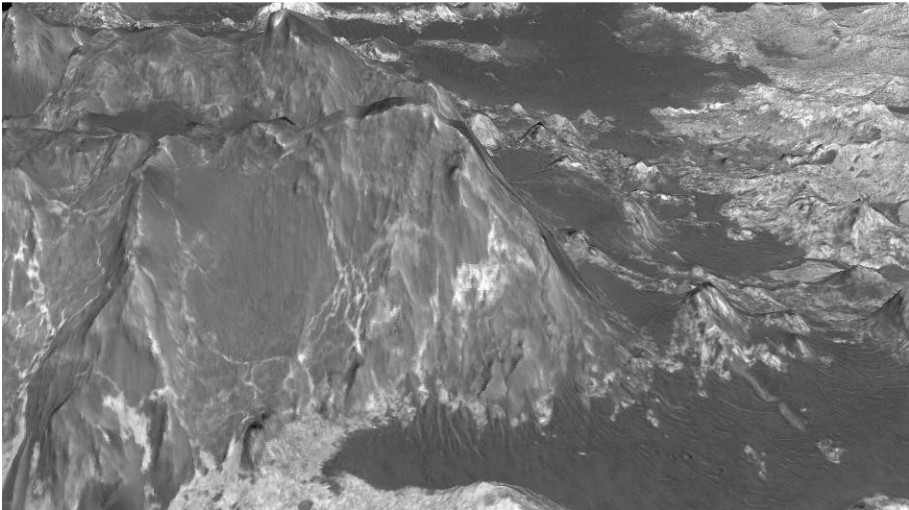
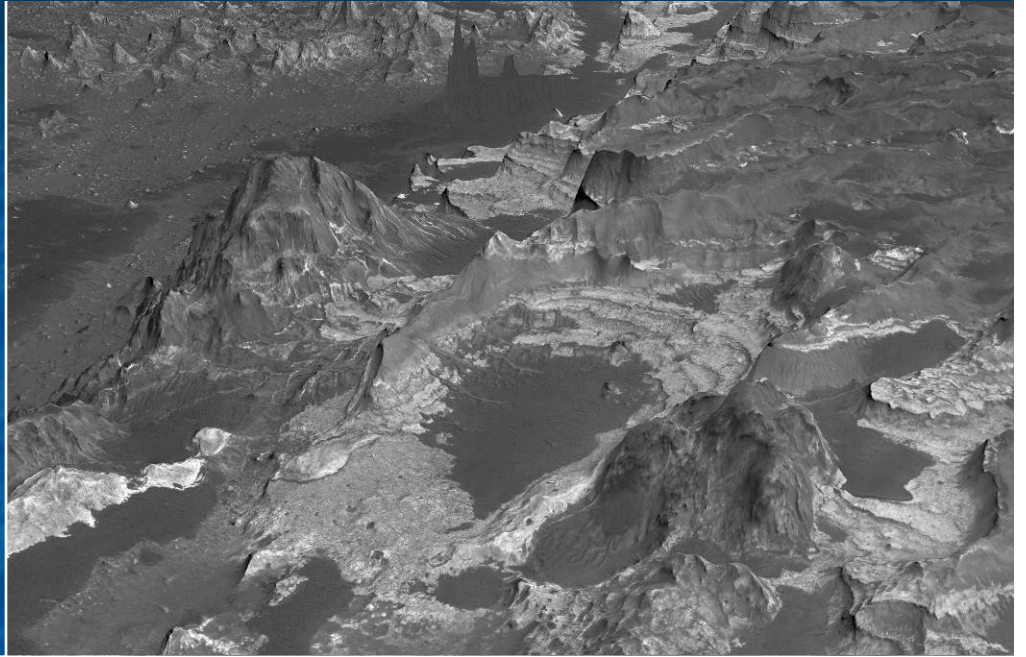
Context

Habitability

Preservation

Morphologic diversity

- Several mounds of exotic material occur in front of the delta
- Appear to underlie deltaic layers
- Possibly contain veins of lighter toned material



Diversity

Context

Habitability

Preservation

Morphologic Diversity

- Several different morphologic units
 - Main delta
 - Several apparent facies
 - Isolated channels
 - Light-toned material on basin floor
 - Basement material

Diversity

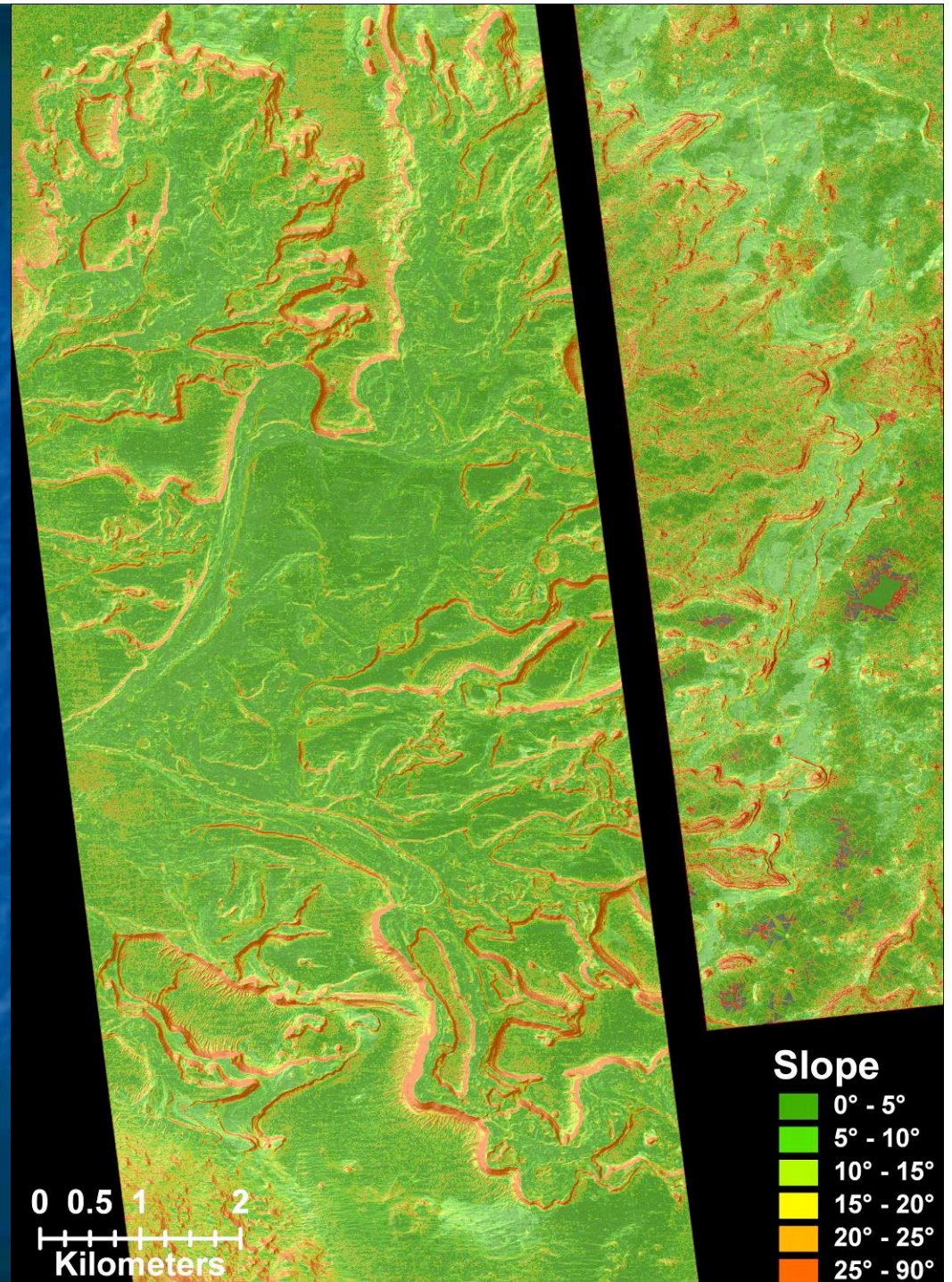
Context

Habitability

Preservation

Traversability

- Generally low slopes along the delta front at 2m scale
- In particular, areas between channels appear to have gentle slopes



Diversity

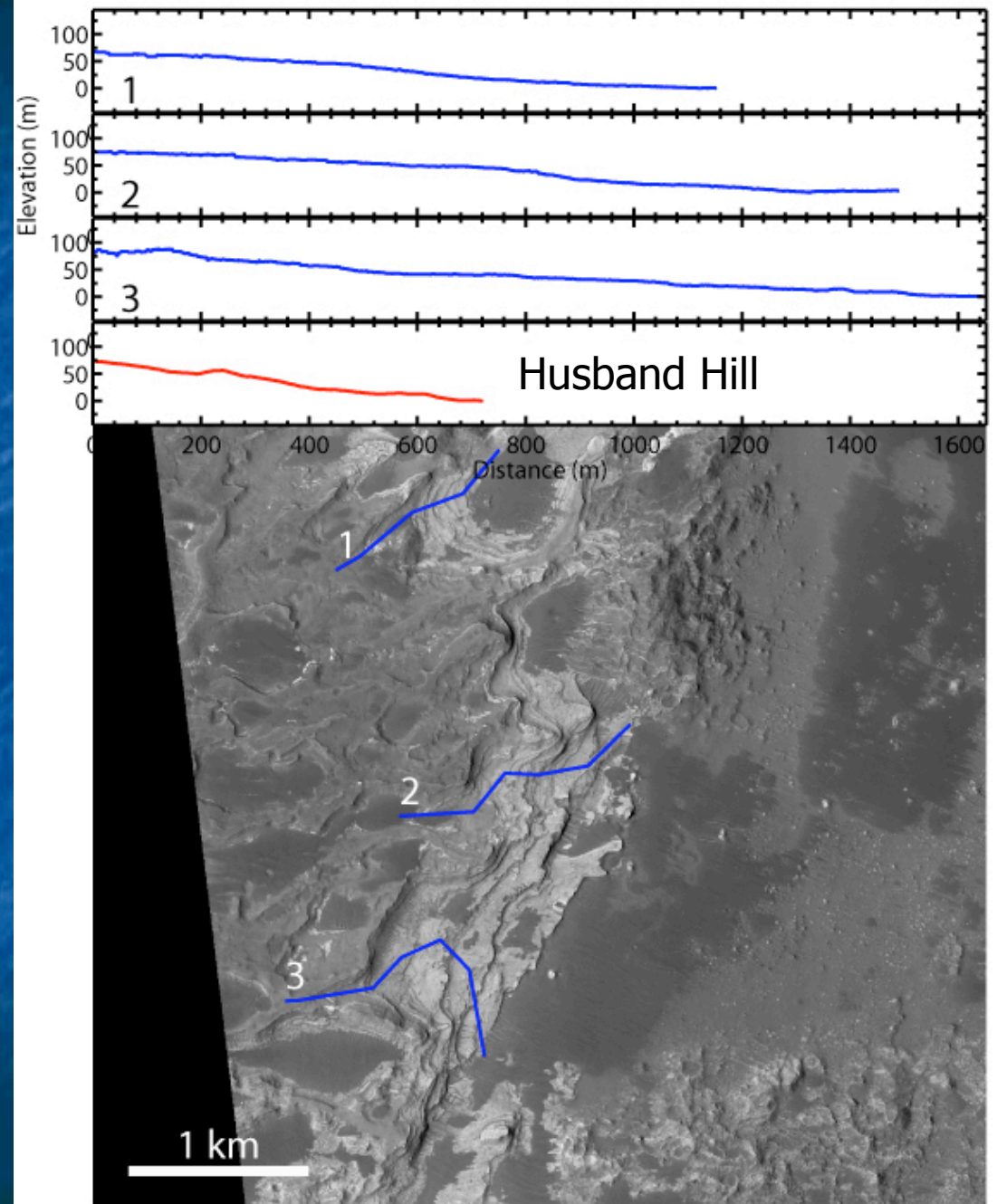
Context

Habitability

Preservation

Traversability

- Key exposures have consistently low slopes averaging only a few degrees



Can multiple working hypotheses be developed for the interpretation of key features, and if so, can the MSL payload enable us to differentiate among alternatives?

- “Unconstrained variables having the greatest influence on calculated discharges and fan **formation time** are grain size and channel depth.” (Jerolmack et al., 2004)
 - Also, are there hiatuses?
- “Individual layers may represent the effects of **switching of the locus of coarse sediment deposition** as avulsions on the delta shift the location of the active delta lobe. The deltaic layers might also reflect the pronounced **quasi-periodic climatic variations** on Mars [Toon et al., 1980] with variations in obliquity, precession and eccentricity over timescales of 10^5 to 10^7 years. Finally, the layers could represent deposition events associated with **individual impacts** according to a Segura et al. [2002] model...” (Moore et al. 2003)
- What was the relative role of aggradation and progradation in the delta construction, and **how stable was the lake** level in Eberswalde? (Lewis et al., 2006)

A good landing site...

(Criteria from Roger Buick)

- Diverse sedimentary rocks
 - Multiple spectral classes and interpreted minerals. Multiple geologic units.
- Long lived water body
 - Lake is inferred; determining duration will be a key objective
- Lithification
 - Inverted relief and cliff-forming layers indicate lithification
- Fine grained material
 - Fluvial processes are expected to sort and distribute sediment in a predictable way
- Minimal oxidization/acidic alteration
 - Exposed phyllosilicates (Ralph Milliken, next talk)
- Little subsequent disturbance
 - Bedding is intact and shows no signs of faulting or deformation
- Recently exposed
 - Entire delta may be recently exhumed (Moore et al. 2003)
- Well understood basic geology
 - YES!

Diversity

Context

Habitability

Preservation

Key Points

- Eberswalde offers a clear geologic context, and a complete, exposed stratigraphic column
- Existing models of deltaic deposition predict where fines & organics should be concentrated
- High resolution stratigraphy conducted from orbital data suggests possible targets
- MSL would be able to address key issues of lake duration and environmental stability

Diversity

Context

Habitability

Preservation